Relion® Protection and Control

650 series
IEC 60870-5-103 Communication Protocol Manual

Power and productivity
for a better world™

Document ID: 1MRK 511 243-UEN
Issued: February 2011
Revision: -
Product version: 1.1

© Copyright 2011 ABB. All rights reserved

Copyright

This document and parts thereof must not be reproduced or copied without written permission from ABB, and the contents thereof must not be imparted to a third party, nor used for any unauthorized purpose.

The software or hardware described in this document is furnished under a license and may be used or disclosed only in accordance with the terms of such license.

Trademarks

ABB and Relion are registered trademarks of ABB Group. All other brand or product names mentioned in this document may be trademarks or registered trademarks of their respective holders.

Warranty

Please inquire about the terms of warranty from your nearest ABB representative.

ABB AB

Substation Automation Products

SE-721 59 Västerås

Sweden

Telephone: +46 (0) 21 32 50 00

Facsimile: +46 (0) 21 14 69 18

http://www.abb.com/substationautomation

Disclaimer

The data, examples and diagrams in this manual are included solely for the concept or product description and are not to be deemed as a statement of guaranteed properties. All persons responsible for applying the equipment addressed in this manual must satisfy themselves that each intended application is suitable and acceptable, including that any applicable safety or other operational requirements are complied with. In particular, any risks in applications where a system failure and/or product failure would create a risk for harm to property or persons (including but not limited to personal injuries or death) shall be the sole responsibility of the person or entity applying the equipment, and those so responsible are hereby requested to ensure that all measures are taken to exclude or mitigate such risks.

This document has been carefully checked by ABB but deviations cannot be completely ruled out. In case any errors are detected, the reader is kindly requested to notify the manufacturer. Other than under explicit contractual commitments, in no event shall ABB be responsible or liable for any loss or damage resulting from the use of this manual or the application of the equipment.

Conformity

This product complies with the directive of the Council of the European Communities on the approximation of the laws of the Member States relating to electromagnetic compatibility (EMC Directive 2004/108/EC) and concerning electrical equipment for use within specified voltage limits (Low-voltage directive 2006/95/EC). This conformity is the result of tests conducted by ABB in accordance with the product standards EN 50263 and EN 60255-26 for the EMC directive, and with the product standards EN 60255-1 and EN 60255-27 for the low voltage directive. The IED is designed in accordance with the international standards of the IEC 60255 series.

Table of contents

Section 1 Introduction....5
This manual....5
Intended audience....5
Product documentation....6
Product documentation set....6
Document revision history....7
Related documents....7
Symbols and conventions....9
Safety indication symbols....9
Manual conventions....9
Functions included in 650 series IEDs....10

Section 2 IEC 60870-5-103 overview....17
IEC 60870-5-103 standard....17

Section 3 IEC 60870-5-103 communication engineering....21
IEC 60870-5-103 engineering in PCM600....21
Specific IEC 60870-5-103 settings....21
Settings....22
IEC 60870-5-103 time synchronization....22

Section 4 IEC 60870-5-103 vendor specific implementation....25
Signals in monitoring direction....25
Measurands for IEC 60870-5-103 I103MEAS....25
Functionality....25
Function block....26
Signals....27
Settings....27
Supported information types....27
Measurands user defined signals for IEC 60870-5-103 I103MEASUSR....28
Functionality....28
Function block....28
Signals....29
Settings....29
Supported information types....29
Function status auto-recloser for IEC 60870-5-103 I103AR....30
Functionality....30
Function block....30
Signals....30

Table of contents

Settings....31
Supported information types....31
Function status earth-fault for IEC 60870-5-103 I103EF....31
Functionality....31
Function block....31
Signals....32
Settings....32
Supported information types....32
Function status fault protection for IEC 60870-5-103 I103FLTPROT....32
Functionality....32
Function block....33
Signals....33
Settings....34
Supported information types....34
IED status for IEC 60870-5-103 I103IED....35
Functionality....35
Function block....36
Signals....36
Settings....36
Supported information types....36
Supervison status for IEC 60870-5-103 I103SUPERV....37
Functionality....37
Function block....37
Signals....37
Settings....38
Supported information types....38
Status for user defined signals for IEC 60870-5-103 I103USRDEF....38
Functionality....38
Function block....39
Signals....39
Settings....40
Supported information types....40
Commands in control direction....41
Function commands for IEC 60870-5-103 I103CMD....41
Functionality....41
Function block....41
Signals....41
Settings....41
Supported information types....42
IED commands for IEC 60870-5-103 I103IEDCMD....42
Functionality....42
Function block....42

Signals....42
Settings....43
Supported information types....43
Function commands user defined for IEC 60870-5-103 I103USRCMD....43
Functionality....43
Function block....43
Signals....44
Settings....44
Supported information types....44
Function commands generic for IEC 60870-5-103 I103GENCMD....45
Functionality....45
Function block....45
Signals....45
Settings....46
Supported information types....46
IED commands with position and select for IEC 60870-5-103 I103POSCMD....46
Functionality....46
Function block....46
Signals....47
Settings....47
Supported information types....47
Disturbance recorder file transfer....47
Disturbance recordings....47

Section 5 Interoperability....51
Physical layer....51
Optical interface....51
Transmission speed....51
Application layer....51
Transmission mode for application data....51
Common address of ASDU....52
Selection of standard information numbers in monitor direction....52
System functions in monitor direction....52
Status indications in monitor direction....52
Supervision indications in monitor direction....53
Earth fault indications in monitor direction....53
Fault indications in monitor direction....53
Auto-reclosure indications in monitor direction....54
Measurands in monitor direction....54
Generic functions in monitor direction....54

Table of contents

Selection of standard information numbers in control direction....55
System functions in control direction....55
General commands in control direction....55
Generic functions in control direction....55
Basic application functions....56
Miscellaneous....56

Section 6 Glossary....59

Section 1 Introduction

1.1 This manual

The communication protocol manual describes a communication protocol supported by the IED. The manual concentrates on vendor-specific implementations.

1.2 Intended audience

This manual addresses the communication system engineer or system integrator responsible for pre-engineering and engineering for communication setup in a substation from an IED perspective.

The system engineer or system integrator must have a basic knowledge of communication in protection and control systems and thorough knowledge of the specific communication protocol.

1.3 Product documentation

1.3.1 Product documentation set

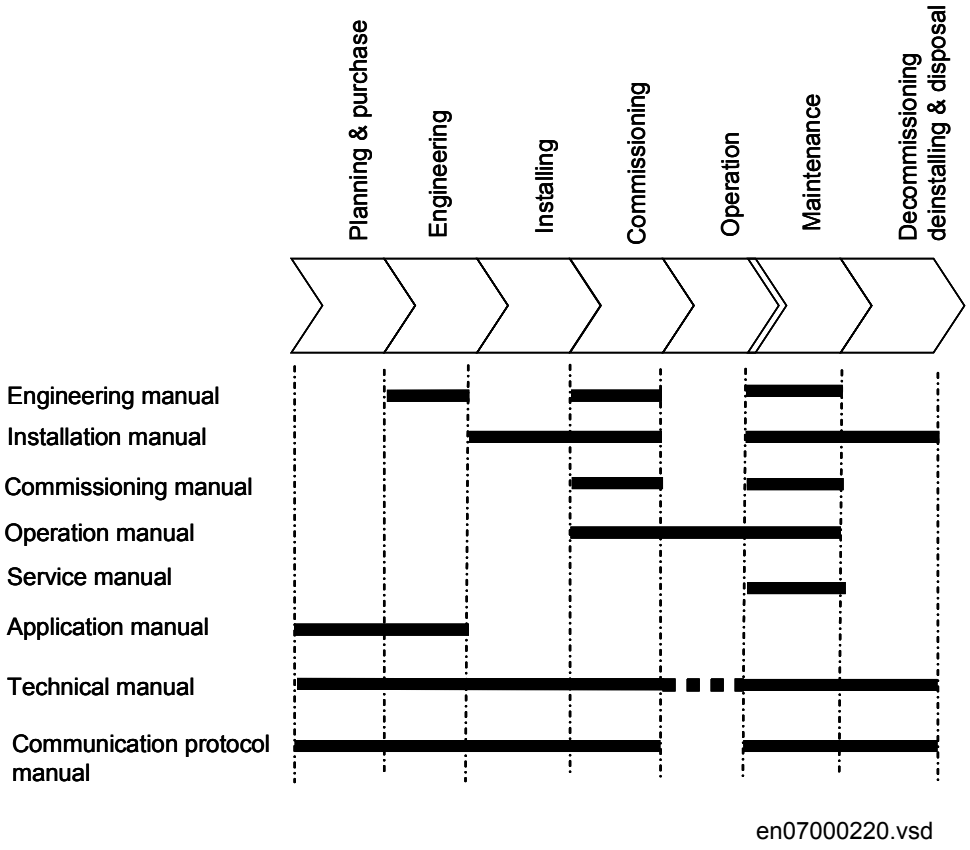

Figure 1: The intended use of manuals in different lifecycles

The engineering manual contains instructions on how to engineer the IEDs using the different tools in PCM600. The manual provides instructions on how to set up a PCM600 project and insert IEDs to the project structure. The manual also recommends a sequence for engineering of protection and control functions, LHMI functions as well as communication engineering for IEC 60870-5-103, IEC 61850 and DNP3.

The installation manual contains instructions on how to install the IED. The manual provides procedures for mechanical and electrical installation. The chapters are organized in chronological order in which the IED should be installed.

The commissioning manual contains instructions on how to commission the IED. The manual can also be used by system engineers and maintenance personnel for assistance during the testing phase. The manual provides procedures for checking of external circuitry and energizing the IED, parameter setting and configuration as

well as verifying settings by secondary injection. The manual describes the process of testing an IED in a substation which is not in service. The chapters are organized in chronological order in which the IED should be commissioned.

The operation manual contains instructions on how to operate the IED once it has been commissioned. The manual provides instructions for monitoring, controlling and setting the IED. The manual also describes how to identify disturbances and how to view calculated and measured power grid data to determine the cause of a fault.

The service manual contains instructions on how to service and maintain the IED. The manual also provides procedures for de-energizing, de-commissioning and disposal of the IED.

The application manual contains application descriptions and setting guidelines sorted per function. The manual can be used to find out when and for what purpose a typical protection function can be used. The manual can also be used when calculating settings.

The technical manual contains application and functionality descriptions and lists function blocks, logic diagrams, input and output signals, setting parameters and technical data sorted per function. The manual can be used as a technical reference during the engineering phase, installation and commissioning phase, and during normal service.

The communication protocol manual describes a communication protocol supported by the IED. The manual concentrates on vendor-specific implementations.

The point list manual describes the outlook and properties of the data points specific to the IED. The manual should be used in conjunction with the corresponding communication protocol manual.

The service manual is not available yet.

1.3.2 Document revision history

Document revision/date	Product series version	History
-/February 2011	1.1	First release

1.3.3 Related documents

Documents related to REB650	Identity number
Application manual	1MRK 505 262-UEN
Technical manual	1MRK 505 263-UEN
Commissioning manual	1MRK 505 264-UEN

Table continues on next page

Documents related to REB650	Identity number
Product Guide, configured	1MRK 505 265-BEN
Type test certificate	1MRK 505 265-TEN

Documents related to REL650	Identity number
Application manual	1MRK 506 325-UEN
Technical manual	1MRK 506 326-UEN
Commissioning manual	1MRK 506 327-UEN
Product Guide, configured	1MRK 506 328-BEN
Type test certificate	1MRK 506 328-TEN

Documents related to RET650	Identity number
Application manual	1MRK 504 124-UEN
Technical manual	1MRK 504 125-UEN
Commissioning manual	1MRK 504 126-UEN
Product Guide, configured	1MRK 504 127-BEN
Type test certificate	1MRK 504 127-TEN

Documents related to REC650	Identity number
Application manual	1MRK 511 246-UEN
Technical manual	1MRK 511 247-UEN
Commissioning manual	1MRK 511 248-UEN
Product Guide	1MRK 511 249-BEN
Type test certificate	1MRK 511 249-TEN

Documents related to REG650	Identity number
Application manual	1MRK 502 033-UEN
Technical manual	1MRK 502 034-UEN
Commissioning manual	1MRK 502 035-UEN
Product Guide	1MRK 502 036-BEN
Type test certificate	1MRK 502 036-TEN
Rotor Earth Fault Protection with Injection Unit RXTTE4 and REG670	1MRG001910

Documents related to REQ650	Identity number
Application manual	1MRK 505 266-UEN
Technical manual	1MRK 505 267-UEN
Commissioning manual	1MRK 505 268-UEN
Product Guide	1MRK 505 269-BEN
Type test certificate	1MRK 505 269-TEN

650 series manuals	Identity number
Communication protocol manual, DNP3	1MRK 511 241-UEN
Communication protocol manual, IEC 61850	1MRK 511 242-UEN
Communication protocol manual, IEC 60870-5-103	1MRK 511 243-UEN
Point list manual, DNP3	1MRK 511 244-UEN
Engineering manual	1MRK 511 245-UEN
Operation manual	1MRK 500 093-UEN
Installation manual	1MRK 514 014-UEN

1.4 Symbols and conventions

1.4.1 Safety indication symbols

The caution icon indicates important information or warning related to the concept discussed in the text. It might indicate the presence of a hazard which could result in corruption of software or damage to equipment or property.

The information icon alerts the reader of important facts and conditions.

The tip icon indicates advice on, for example, how to design your project or how to use a certain function.

Although warning hazards are related to personal injury, it is necessary to understand that under certain operational conditions, operation of damaged equipment may result in degraded process performance leading to personal injury or death. Therefore, comply fully with all warning and caution notices.

1.4.2 Manual conventions

Conventions used in IED manuals. A particular convention may not be used in this manual.

- Abbreviations and acronyms in this manual are spelled out in the glossary. The glossary also contains definitions of important terms.
- Push button navigation in the LHMI menu structure is presented by using the push button icons, for example:
  To navigate between the options, use and .
- HMI menu paths are presented in bold, for example:
  Select **Main menu/Settings**.

- LHMI messages are shown in Courier font, for example:
  To save the changes in non-volatile memory, select Yes and press .
- Parameter names are shown in italics, for example:
  The function can be enabled and disabled with the *Operation* setting.
- The ^ character in front of an input or output signal name in the function block symbol given for a function, indicates that the user can set an own signal name in PCM600.
- The * character after an input or output signal name in the function block symbol given for a function, indicates that the signal must be connected to another function block in the application configuration to achieve a valid application configuration.

1.4.3 Functions included in 650 series IEDs

Table 1: Main protection functions

IEC 61850 / Function block name	ANSI	Function description
Differential protection		
T2WPDIF	87T	Transformer differential protection, two winding
T3WPDIF	87T	Transformer differential protection, three winding
REFPDIF	87N	Restricted earth fault protection, low impedance
HZPDIF	87	1Ph High impedance differential protection
GENPDIF	87G	Generator differential protection
Impedance protection		
ZQDPDIS	21	Five-zone distance protection, quadrilateral characteristic
FDPSPDIS	21	Phase selection with load enchroachment, quadrilateral characteristic
ZMOPDIS	21	Five-zone distance protection, mho characteristic
FMPSPDIS	21	Faulty phase identification with load enchroachment for mho
ZDNRDIR	21	Directional impedance quadrilateral and mho
PPLPHIZ		Phase preference logic
ZMRPSB	68	Power swing detection
ZCVPSOF		Automatic switch onto fault logic, voltage-and current-based
ZGPDIS	21G	Underimpedance protection for generators and transformers
LEXPDIS	40	Loss of excitation
OOSPPAM	13	Out-of-step protection
LEPDIS		Load enchroachment

Table 2: Backup protection functions

IEC 61850 / Function block name	ANSI	Function description
Current protection		
PHPIOC	50	Instantaneous phase overcurrent protection
SPTPIOC	50	Instantaneous phase overcurrent protection
OC4PTOC	51/67	Four-step phase overcurrent protection
OC4SPTOC	51/67	Four-step phase overcurrent protection
EFPIOC	50N	Instantaneous residual overcurrent protection
EF4PTOC	51N/67N	Four-step directional residual overcurrent protection
SDEPSDE	67N	Sensitive directional residual overcurrent and power protection
UC2PTUC	37	Time-delayed two-step undercurrent protection
LPTTR	26	Thermal overload protection, one time constant
TRPTTR	49	Thermal overload protection, two time constants
CCRBRF	50BF	Breaker failure protection
CSPRBRF	50BF	Breaker failure protection
STBPTOC	50STB	Stub protection
CCRPLD	52PD	Pole discordance protection
BRCPTOC	46	Broken conductor check
GUPPDUP	37	Directional underpower protection
GOPPDOP	32	Directional overpower protection
DNSPTOC	46	Negative sequence-based overcurrent function
AEGGAPC	50AE	Accidental energizing protection for synchronous generator
NS2PTOC	46I2	Negative-sequence time overcurrent protection for machines
VR2PVOC	51V	Voltage-restrained time overcurrent protection
Voltage protection		
UV2PTUV	27	Two-step undervoltage protection
OV2PTOV	59	Two-step overvoltage protection
ROV2PTOV	59N	Two-step residual overvoltage protection
OEXPVPH	24	Overexcitation protection
LOVPTUV	27	Loss-of-voltage check
STEFPHIZ	64	100% Stator earth fault protection, 3rd harmonic based
Frequency protection		
SAPTUF	81	Underfrequency function
SAPTOF	81	Overfrequency function
SAPFRC	81	Rate-of-change frequency protection

Table 3: Control and monitoring functions

IEC 61850 / Function block name	ANSI	Function description
Control		
SESRSYN	25	Synchrocheck, energizing check and synchronizing
SMBRREC	79	Autorecloser
STBRREC	79	Autorecloser
SCILO	3	Logical node for interlocking
BB_ES	3	Interlocking for busbar earthing switch
A1A2_BS	3	Interlocking for bus-section breaker
A1A2_DC	3	Interlocking for bus-section disconnector
ABC_BC	3	Interlocking for bus-coupler bay
BH_CONN	3	Interlocking for 1 1/2 breaker diameter
BH_LINE_A	3	Interlocking for 1 1/2 breaker diameter
BH_LINE_B	3	Interlocking for 1 1/2 breaker diameter
DB_BUS_A	3	Interlocking for double CB bay
DB_BUS_B	3	Interlocking for double CB bay
DB_LINE	3	Interlocking for double CB bay
ABC_LINE	3	Interlocking for line bay
AB_TRAFO	3	Interlocking for transformer bay
SCSWI		Switch controller
SXCBR		Circuit breaker
SXSWI		Circuit switch
POS_EVAL		Evaluation of position indication
SELGGIO		Select release
QCBAY		Bay control
LOCREM		Handling of LR-switch positions
LOCREMCTRL		LHMI control of PSTO
APC8		Apparatus control for single bay, max 8 app. (1CB) incl. interlocking
TR8ATCC	90	Automatic voltage control for tap changer, parallel control
TCMYLTC	84	Tap changer control and supervision, 6 binary inputs
SLGGIO		Logic-rotating Switch for function selection and LHMI presentation
VSGGIO		Selector mini switch extension
DPGGIO		IEC61850 generic communication I/O functions double point
SPC8GGIO		Single-point generic control 8 signals
AUTOBITS		AutomationBits, command function for DNP3.0
I103CMD		Function commands for IEC60870-5-103
I103IEDCMD		IED commands for IEC60870-5-103
I103USRCMD		Function commands user defined for IEC60870-5-103
I103GENCMD		Function commands generic for IEC60870-5-103

Table continues on next page

IEC 61850 / Function block name	ANSI	Function description
I103POSCMD		IED commands with position and select for IEC60870-5-103
Secondary system supervision		
CCSRDIF	87	Current circuit supervision
SDDRFUF		Fuse failure supervision
TCSSCBR		Breaker close/trip circuit monitoring
Logic		
SMPPTRC	94	Tripping logic
SPTPTRC	94	Tripping logic
TMAGGIO		Trip matrix logic
OR		Configurable logic blocks, OR
INVERTER		Configurable logic blocks, Inverter
PULSETIMER		Configurable logic blocks, PULSETIMER
GATE		Configurable logic blocks, Controllable gate
XOR		Configurable logic blocks, exclusive OR
LOOPDELAY		Configurable logic blocks, loop delay
TimeSet		Configurable logic blocks, timer
AND		Configurable logic blocks, AND
SRMEMORY		Configurable logic blocks, set-reset memory
RSMEMORY		Configurable logic blocks, reset-set memory
ANDQT		Configurable logic Q/T, ANDQT
ORQT		Configurable logic Q/T, ORQT
INVERTERQT		Configurable logic Q/T, INVERTERQT
XORQT		Configurable logic Q/T, XORQT
SRMEMORYQT		Configurable logic Q/T, set-reset with memory
RSMEMORYQT		Configurable logic Q/T, reset-set with memory
TIMERSETQT		Configurable logic Q/T, settable timer
PULSETIMERQT		Configurable logic Q/T, pulse timer
INVALIDQT		Configurable logic Q/T, INVALIDQT
INDCOMBSPQT		Configurable logic Q/T, single-indication signal combining
INDEXTSPQT		Configurable logic Q/T, single-indication signal extractor
FXDSIGN		Fixed-signal function block
B16I		Boolean 16 to Integer conversion
B16IFCVI		Boolean 16 to Integer conversion with logic node representation
IB16A		Integer to Boolean 16 conversion
IB16FCVB		Integer to boolean 16 conversion with logic node representation
Monitoring		
CVMMXN		Measurements
CMMXU		Phase current measurement

Table continues on next page

IEC 61850 / Function block name	ANSI	Function description
VMMXU		Phase-phase voltage measurement
CMSQI		Current sequence component measurement
VMSQI		Voltage sequence measurement
VNMMXU		Phase-neutral voltage measurement
AISVBAS		Function block for service values presentation of the analog inputs
TM_P_P2		Function block for service value presentation of primary analog inputs 600TRM
AM_P_P4		Function block for service value presentation of primary analog inputs 600AIM
TM_S_P2		Function block for service value presentation of secondary analog inputs 600TRM
AM_S_P4		Function block for service value presentation of secondary analog inputs 600AIM
CNTGGIO		Event counter
DRPRDRE		Disturbance report
AxRADR		Analog input signals
BxRBDR		Binary input signals
SPGGIO		IEC61850 generic communication I/O functions
SP16GGIO		IEC61850 generic communication I/O functions 16 inputs
MVGGIO		IEC61850 generic communication I/O functions
MVEXP		Measured value expander block
LMBRFLO		Fault locator
SPVNZBAT		Station battery supervision
SSIMG	63	Insulation gas-monitoring function
SSIML	71	Insulation liquid-monitoring function
SSCBR		Circuit breaker condition monitoring
I103MEAS		Measurands for IEC60870-5-103
I103MEASUSR		Measurands user defined signals for IEC60870-5-103
I103AR		Function status auto-recloser for IEC60870-5-103
I103EF		Function status earth-fault for IEC60870-5-103
I103FLTPROT		Function status fault protection for IEC60870-5-103
I103IED		IED status for IEC60870-5-103
I103SUPERV		Supervision status for IEC60870-5-103
I103USRDEF		Status for user defiend signals for IEC60870-5-103
Metering		
PCGGIO		Pulse counter logic
ETPMMTR		Function for energy calculation and demand handling

Table 4: Designed to communicate

IEC 61850 / Function block name	ANSI	Function description
Station communication		
IEC61850-8-1		IEC61850 communication protocol
DNPGEN CH1TCP CH2TCP CH3TCP CH4TCP MST1TCP MST2TCP MST3TCP MST4TCP		DNP3.0 for TCP/IP communication protocol
DNPFREC		DNP3.0 fault records for TCP/IP communication protocol
IED61870-5-103		IEC60870-5-103 serial communication via COM02
GOOSEINTLKRCV		Horizontal communication via GOOSE for interlocking
GOOSEBINRCV		GOOSE binary receive
GOOSEVCTRCONF		GOOSE VCTR configuration for send and receive
VCTRSEND		Voltage control sending block for GOOSE
GOOSEVCTRRCV		Voltage control receiving block for GOOSE
ETHFRNT ETHLAN1 GATEWAY		Ethernet configuration of front port, LAN1 port and gateway
GOOSEDPRCV		GOOSE function block to receive a double point value
GOOSEINTRCV		GOOSE function block to receive an integer value
GOOSEMVRCV		GOOSE function block to receive a measurand value
GOOSESPRCV		GOOSE function block to receive a single point value
Scheme communication		
ZCPSCH	85	Scheme communication logic for distance or overcurrent protection
ZCRWPSCH	85	Current reversal and weak end infeed logic for distance protection
ZCWSPSCH	85	Current reversal and weak end infeed logic for distance protection
ZCLCPLAL		Local acceleration logic
ECPSCH	85	Scheme communication logic for residual overcurrent protection
ECRWPSCH	85	Current reversal and weak end infeed logic for residual overcurrent protection

Table 5: Basic IED functions

IEC 61850 / Function block name	Function description
Basic functions included in all products	
INTERRSIG	Self-supervision with internal event list
SELFSUPEVLST	Self-supervision with internal event list
TIMESYNCHGEN	Time synchronization
SNTP	Time synchronization

Table continues on next page

IEC 61850 / Function block name	Function description
DTSBEGIN	Time synchronization
DTSEND	Time synchronization
TIMEZONE	Time synchronization
IRIG-B	Time synchronization
SETGRPS	Setting group handling
ACTVGRP	Parameter setting groups
TESTMODE	Test mode functionality
CHNGLCK	Change lock function
ATHSTAT	Authority status
ATHCHCK	Authority check
TERMINALID	IED identifiers
PRODINF	Product information
PRIMVAL	Primary system values
SMAI_20_1 - SMAI_20_12	Signal Matrix for analog inputs
3PHSUM	Summation block 3 phase
GBASVAL	Global base values for settings
DOSFRNT	Denial of service, frame rate control for front port
DOSLAN1	Denial of service, frame rate control for LAN1 port
DOSSCKT	Denial of service, socket flow control

Section 2 IEC 60870-5-103 overview

2.1 IEC 60870-5-103 standard

IEC 60870-5-103 is defined as a companion standard for the informative element of protection equipment. While the official IEC 60870-5-103 standard dates back to 1997, the protocol has its roots in the VDEW6 communication protocol from the late 1980's. A VDEW6 device can be seen as a subset of an IEC 60870-5-103 device but not the opposite.

IEC 60870-5-103 defines communication for a serial, unbalanced link only. Communication speeds are defined as either 9600 or 19200 baud.

Standard documentation

This manual assumes that the reader has some basic knowledge of the IEC 60870-5-103 protocol and the standard IEC 60870 documents relating to the protocol.

Table 6: Standard IEC 60870 documents relating to IEC 60870-5-103

IEC 60870 document part	Description
5-1	Transmission frame formats
5-2	Link transmission procedures
5-3	General structure of application data
5-4	Definition and coding of application information elements
5-5	Basic application functions
5-6	Conformance testing guidelines
5-103	Companion standard for the informative interface of protection equipment.

The IEC 60870-5-1…6 parts are also used in communication protocols like IEC 60870-5-101 and IEC 60870-5-104.

Interoperability and interchangeability

An IEC 60870-5-103 device can be interoperable and interchangeable, or only interoperable. Interoperability means that any required application data in the device, which can be coded into an IEC 60870-5-103 data type, can be mapped into the IEC 60870-5-103 address space. This data is recognized by any IEC 60870-5-103 master.

Interchangeability means supporting the application data (informative elements) whose semantics are pre-defined by the IEC 60870-5-103 standard. However, only a very limited set of application data informative elements has been defined by the

standard. It should also be noticed that these sets of data are mainly defined for a single function protection IED. 650 series IEDs in turn are multifunctional protection and control IEDs whose internal data model is based on the IEC 61850 standard.

Interoperability list

The standard requires the IEC 60870-5-103 device to provide an interoperability list, which actually is more an interchangeability list. See the vendor specific implementation section in this manual for the interoperability list.

Data mapping principle

Almost all IEC 60870-5-103 process data in the IED is mapped into private function types and information numbers. General principle of the mapping is to keep all process data belonging to the same function design inside the same IEC 60870-5-103 function type definition. However, if this mapping principle causes interoperability problems with older installations, the user can freely remap every available IEC 60870-5-103 process data point by using PCM600.

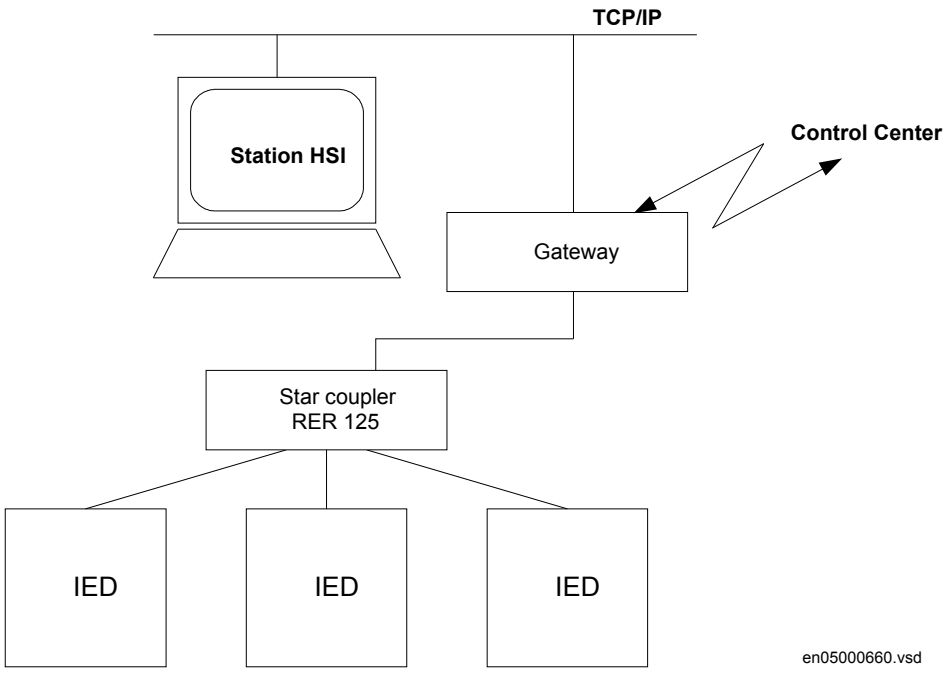

Figure 2: Example of IEC 60870-5-103 communication structure for a substation automation system

IEC 60870-5-103 communication protocol is mainly used when a protection IED communicates with a third party control or monitoring system. This system must have software that can interpret the IEC 60870-5-103 communication messages.

When communicating locally in the station using a Personal Computer (PC) or a Remote Terminal Unit (RTU) connected to the Communication and processing

module, the only hardware needed is optical fibres (glass/plastic) and an opto/electrical converter for the PC/RTU.

Table 7: Max distances between IED/nodes

Connector	Distance
glass (ST connector)	< 1000 m according to optical budget

Section 3 IEC 60870-5-103 communication engineering

3.1 IEC 60870-5-103 engineering in PCM600

The Application Configuration tool (ACT) and the Parameter Setting tool (PST) in PCM600 are used to configure the communication for IEC 60870-5-103 protocol.

1. Add the desired IEC 60870-5-103 function blocks to the application configuration in the Application Configuration tool.
2. Connect the outputs of desired protection and monitoring function in the application configuration to the inputs of the corresponding IEC 60870-5-103 function block.
3. Set the function type and desired information number, where an information number must be supplied, for each IEC 60870-5-103 function block instance in the Parameter Setting tool.

3.2 Specific IEC 60870-5-103 settings

Set parameter *Operation* to *On* either in Parameter Setting tool or from the local HMI.

Parameter *Operation* is found under **Main menu/Configuration/Communication/ Station/communication/1:IEC60870-5-103** in local HMI. The IED is automatically restarted when parameter *Operation* is set.

IEC60870-5-103: 1					
Operation		Off			
SlaveAddress		1		1	31
BaudRate		9600 Bd			
RevPolarity		On			
CycMeasRepTime		5,0	s	1,0	1800,0
MasterTimeDomain		UTC			
TimeSyncMode		IEDTime			
EvalTimeAccuracy		5ms			
EventRepMode		SeqOfEvent			

Figure 3: Settings under IEC60870-5-103:1 in Local HMI

The general settings for IEC 60870-5-103 communication are the following:

- *SlaveAddress* and *BaudRate*: Settings for slave number and communication speed (baud rate).
  The slave number can be set to any value between 1 and 31. The communication speed, can be set either to 9600 bits/s or 19200 bits/s
- *RevPolarity*: Setting for inverting the light (or not).
- *CycMeasRepTime*: Setting for *CycMeasRepTime* must be coordinated with the *xDbRepInt* and *xAngDbRepInt* reporting setting on the MMXU measurement function blocks. See I103MEAS function block for more information.
- *EventRepMode*: Defines the mode for how events are reported.
  The event buffer size is 1000 events.

3.2.1 Settings

Table 8: IEC60870-5-103 Non group settings (basic)

Name	Values (Range)	Unit	Step	Default	Description
Operation	Off On	-	-	Off	Operation
SlaveAddress	1 - 31	-	1	1	Slave address
BaudRate	9600 Bd 19200 Bd	-	-	9600 Bd	Baudrate on serial line
RevPolarity	Off On	-	-	On	Invert polarity
CycMeasRepTime	1.0 - 1800.0	s	0.1	5.0	Cyclic reporting time of measurments
MasterTimeDomain	UTC Local Local with DST	-	-	UTC	Master time domain
TimeSyncMode	IEDTime LinMastTime IEDTimeSkew	-	-	IEDTime	Time synchronization mode
EvalTimeAccuracy	5ms 10ms 20ms 40ms Off	-	-	5ms	Evaluate time accuracy for invalid time
EventRepMode	SeqOfEvent HiPriSpont	-	-	SeqOfEvent	Event reporting mode

3.3 IEC 60870-5-103 time synchronization

An IED with IEC 60870-5-103 protocol can be used for time synchronization, but for accuracy reasons, it is not recommended. In some cases, however, this kind of synchronization is needed, for example, when no other synchronization is available.

First, set the IED to be synchronized via IEC 60870-5-103 either from **IED Configuration/Time/Synchronization/TIMESYNCHGEN:1** in PST or from the local HMI.

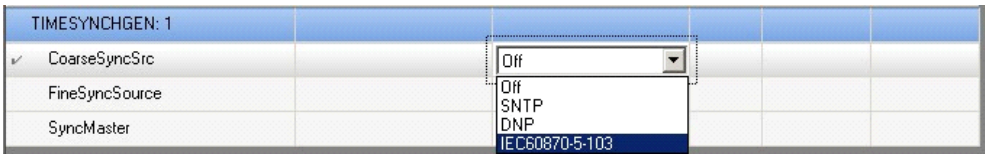

Figure 4: Settings under TIMESYNCHGEN:1 in PST

Only *CoarseSyncSrc* can be set to IEC 60870-5-103, not *FineSyncSource*.

After setting up the time synchronization source, the user must check and modify the IEC 60870-5-103 time synchronization specific settings, under: **IED Configuration/Communication/Station communication/IEC60870-5-103:1**.

- *MasterTimeDomain* specifies the format of the time sent by the master. Format can be:
  - Coordinated Universal Time (UTC)
  - Local time set in the master (Local)
  - Local time set in the master adjusted according to daylight saving time (Local with DST)
- *TimeSyncMode* specifies the time sent by the IED. The time synchronisation is done using the following ways:
  - *IEDTime*: The IED sends the messages with its own time.
  - *LinMasTime*: The IED measures the offset between its own time and the master time, and applies the same offset for the messages sent as in the *IEDTimeSkew*. But in *LinMasTime* it applies the time changes occurred between two synchronised messages.
  - *IEDTimeSkew*: The IED measures the offset in between its own time and the master time and applies the same offset for the messages sent.
- *EvalTimeAccuracy* evaluates time accuracy for invalid time. Specifies the accuracy of the synchronization (5, 10, 20 or 40 ms). If the accuracy is worse than the specified value, the “Bad Time” flag is raised. To accommodate those masters that are really bad in time sync, the *EvalTimeAccuracy* can be set to *Off*.

According to the standard, the “Bad Time” flag is reported when synchronization has been omitted in the protection for >23 h.

Section 4 IEC 60870-5-103 vendor specific implementation

The signal and setting tables specify the information types supported by the IEDs with the communication protocol IEC 60870-5-103 implemented.

The information types are supported when corresponding functions are included in the protection and control IED.

4.1 Signals in monitoring direction

4.1.1 Measurands for IEC 60870-5-103 I103MEAS

4.1.1.1 Functionality

103MEAS is a function block that reports all valid measuring types depending on connected signals.

The measurand reporting interval set for MMXU function blocks, using the *xDbRepInt* and *xAngDbRepInt* settings, must be coordinated with the event reporting interval set for the IEC 60870-5-103 communication using setting *CycMeasRepTime*.

CMMXU: 1					
Operation		Off			
GlobalBaseSel		1		1	6
ILDbRepInt		10	Type	1	300
ILZeroDb		500	m%	0	100000
ILHiHiLim		1200	A	0	500000
ILHiLim		1100	A	0	500000
ILLowLim		0	A	0	500000
ILLowLowLim		0	A	0	500000
ILMin		0	A	0	500000
ILMax		1300	A	0	500000
ILRepTyp		**Cyclic**			
ILLimHys		5,000	%	0,000	100,000
ILAngDbRepInt		10	Type	1	300
IAmpComp5		0,000	%	-10,000	10,000
IAmpComp30		0,000	%	-10,000	10,000
IAmpComp100		0,000	%	-10,000	10,000
IAngComp5		0,000	Deg	-10,000	10,000
IAngComp30		0,000	Deg	-10,000	10,000
IAngComp100		0,000	Deg	-10,000	10,000

Figure 5: Settings for CMMXU: 1

All input signals to IEC 60870-5-103 I103MEAS must be connected in application configuration. Connect an input signals on IEC 60870-5-103 I103MEAS that is not connected to the corresponding output on MMXU function, to outputs on the fixed signal function block.

4.1.1.2 Function block

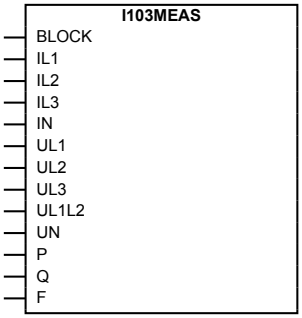

Figure 6: I103MEAS function block

4.1.1.3 Signals

Table 9: I103MEAS Input signals

Name	Type	Default	Description
BLOCK	BOOLEAN	0	Block of service value reporting
IL1	REAL	0.0	Service value for current phase L1
IL2	REAL	0.0	Service value for current phase L2
IL3	REAL	0.0	Service value for current phase L3
IN	REAL	0.0	Service value for residual current IN
UL1	REAL	0.0	Service value for voltage phase L1
UL2	REAL	0.0	Service value for voltage phase L2
UL3	REAL	0.0	Service value for voltage phase L3
UL1L2	REAL	0.0	Service value for voltage phase-phase L1-L2
UN	REAL	0.0	Service value for residual voltage UN
P	REAL	0.0	Service value for active power
Q	REAL	0.0	Service value for reactive power
F	REAL	0.0	Service value for system frequency

4.1.1.4 Settings

Table 10: I103MEAS Non group settings (basic)

Name	Values (Range)	Unit	Step	Default	Description
FunctionType	1 - 255	-	1	1	Function type (1-255)
MaxIL1	1 - 99999	A	1	3000	Maximum current phase L1
MaxIL2	1 - 99999	A	1	3000	Maximum current phase L2
MaxIL3	1 - 99999	A	1	3000	Maximum current phase L3
MaxIN	1 - 99999	A	1	3000	Maximum residual current IN
MaxUL1	0.05 - 2000.00	kV	0.05	230.00	Maximum voltage for phase L1
MaxUL2	0.05 - 2000.00	kV	0.05	230.00	Maximum voltage for phase L2
MaxUL3	0.05 - 2000.00	kV	0.05	230.00	Maximum voltage for phase L3
MaxUL1-UL2	0.05 - 2000.00	kV	0.05	400.00	Maximum voltage for phase-phase L1-L2
MaxUN	0.05 - 2000.00	kV	0.05	230.00	Maximum residual voltage UN
MaxP	0.00 - 2000.00	MW	0.05	1200.00	Maximum value for active power
MaxQ	0.00 - 2000.00	MVA	0.05	1200.00	Maximum value for reactive power
MaxF	50.0 - 60.0	Hz	10.0	50.0	Maximum system frequency

4.1.1.5 Supported information types

Measurands in public range, I103MEAS

Number of instances: 1

The IED reports all valid measuring types depending on connected signals.

Upper limit for measured currents, active/reactive-power is 2.4 times rated value.

Upper limit for measured voltages and frequency is 1.2 times rated value.

Info. no.	Message	Supported
148	IL1	Yes
144, 145, 148	IL2	Yes
148	IL3	Yes
147	IN, Neutral current	Yes
148	UL1	Yes
148	UL2	Yes
148	UL3	Yes
145, 146	UL1-UL2	Yes
147	UN, Neutral voltage	Yes
146, 148	P, active power	Yes
146, 148	Q, reactive power	Yes
148	f, frequency	Yes

4.1.2 Measurands user defined signals for IEC 60870-5-103 I103MEASUSR

4.1.2.1 Functionality

I103MEASUSR is a function block with user defined input measurands in monitor direction. These function blocks include the *FunctionType* parameter for each block in the private range, and the Information number parameter for each block.

4.1.2.2 Function block

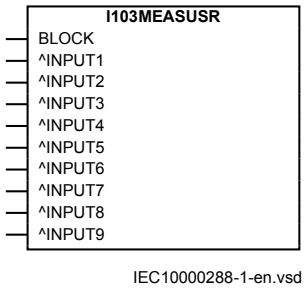

Figure 7: I103MEASUSR function block

4.1.2.3 Signals

Table 11: I103MEASUSR Input signals

Name	Type	Default	Description
BLOCK	BOOLEAN	0	Block of service value reporting
INPUT1	REAL	0.0	Service value for measurement on input 1
INPUT2	REAL	0.0	Service value for measurement on input 2
INPUT3	REAL	0.0	Service value for measurement on input 3
INPUT4	REAL	0.0	Service value for measurement on input 4
INPUT5	REAL	0.0	Service value for measurement on input 5
INPUT6	REAL	0.0	Service value for measurement on input 6
INPUT7	REAL	0.0	Service value for measurement on input 7
INPUT8	REAL	0.0	Service value for measurement on input 8
INPUT9	REAL	0.0	Service value for measurement on input 9

4.1.2.4 Settings

Table 12: I103MEASUSR Non group settings (basic)

Name	Values (Range)	Unit	Step	Default	Description
FunctionType	1 - 255	-	1	25	Function type (1-255)
InfNo	1 - 255	-	1	1	Information number for measurands (1-255)
MaxMeasur1	0.05 - 10000000000.00	-	0.05	1000.00	Maximum value for measurement on input 1
MaxMeasur2	0.05 - 10000000000.00	-	0.05	1000.00	Maximum value for measurement on input 2
MaxMeasur3	0.05 - 10000000000.00	-	0.05	1000.00	Maximum value for measurement on input 3
MaxMeasur4	0.05 - 10000000000.00	-	0.05	1000.00	Maximum value for measurement on input 4
MaxMeasur5	0.05 - 10000000000.00	-	0.05	1000.00	Maximum value for measurement on input 5
MaxMeasur6	0.05 - 10000000000.00	-	0.05	1000.00	Maximum value for measurement on input 6
MaxMeasur7	0.05 - 10000000000.00	-	0.05	1000.00	Maximum value for measurement on input 7
MaxMeasur8	0.05 - 10000000000.00	-	0.05	1000.00	Maximum value for measurement on input 8
MaxMeasur9	0.05 - 10000000000.00	-	0.05	1000.00	Maximum value for measurement on input 9

4.1.2.5 Supported information types

Measurands in private range, I103MEASUSR

Number of instances: 3

Function type parameter for each block in private range. Default values are defined in private range 25 – 27. One for each instance.

Information number must be selected for measurands.

Info.	Message	Supported
*1)	Meas1	Yes
*	Meas2	Yes
*	Meas3	Yes
*	Meas4	Yes
*	Meas5	Yes
*	Meas6	Yes
*	Meas7	Yes
*	Meas8	Yes
*	Meas9	Yes

1) * User defined information number

4.1.3 Function status auto-recloser for IEC 60870-5-103 I103AR

4.1.3.1 Functionality

I103AR is a function block with defined functions for autorecloser indications in monitor direction. This block includes the *FunctionType* parameter, and the information number parameter is defined for each output signal.

4.1.3.2 Function block

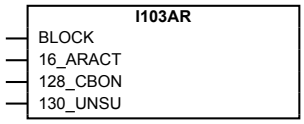

Figure 8: I103AR function block

4.1.3.3 Signals

Table 13: I103AR Input signals

Name	Type	Default	Description
BLOCK	BOOLEAN	0	Block of status reporting
16_ARACT	BOOLEAN	0	Information number 16, auto-recloser active
128_CBON	BOOLEAN	0	Information number 128, circuit breaker on by auto-recloser
130_UNSU	BOOLEAN	0	Information number 130, unsuccessful reclosing

4.1.3.4 Settings

Table 14: I103AR Non group settings (basic)

Name	Values (Range)	Unit	Step	Default	Description
FunctionType	1 - 255	-	1	1	Function type (1-255)

4.1.3.5 Supported information types

Autorecloser indications in monitor direction, I103AR

Number of instances: 1

Function type is selected with parameter *FunctionType*.

Information number is defined for each output signal.

Info. no.	Message	Supported
16	Autorecloser active	Yes
17	Teleprotection active	No
18	Protection active	No
128	CB on by Autorecloser	Yes
129	CB ‘on’ by long-time AR	No
130	Autorecloser blocked	Yes

4.1.4 Function status earth-fault for IEC 60870-5-103 I103EF

4.1.4.1 Functionality

I103EF is a function block with defined functions for earth fault indications in monitor direction. This block includes the *FunctionType* parameter, and the information number parameter is defined for each output signal.

4.1.4.2 Function block

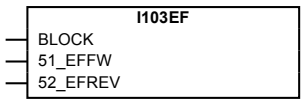

Figure 9: I103EF function block

4.1.4.3 Signals

Table 15: I103EF Input signals

Name	Type	Default	Description
BLOCK	BOOLEAN	0	Block of status reporting
51_EFFW	BOOLEAN	0	Information number 51, earth-fault forward
52_EFREV	BOOLEAN	0	Information number 52, earth-fault reverse

4.1.4.4 Settings

Table 16: I103EF Non group settings (basic)

Name	Values (Range)	Unit	Step	Default	Description
FunctionType	1 - 255	-	1	160	Function type (1-255)

4.1.4.5 Supported information types

Earth fault indications in monitor direction, I103EF

Number of instances: 1

Function type is selected with parameter *FunctionType*.

Information number is defined for each output signal.

Info. no.	Message	Supported
48	Earth fault L1	No
49	Earth fault L2	No
50	Earth fault L3	No
51	Earth fault forward	Yes
52	Earth fault reverse	Yes

4.1.5 Function status fault protection for IEC 60870-5-103 I103FLTPROT

4.1.5.1 Functionality

I103FLTPROT is used for fault indications in monitor direction. Each input on the function block is specific for a certain fault type and therefore must be connected to a correspondent signal present in the configuration. For example: 68_TRGEN represents the General Trip of the device, and therefore must be connected to the general trip signal SMPPTRC_TRIP or equivalent.

The delay observed in the protocol is the time difference in between the signal that is triggering the Disturbance Recorder and the respective configured signal to the IEC 60870-5-103 I103FLTPROT.

4.1.5.2 Function block

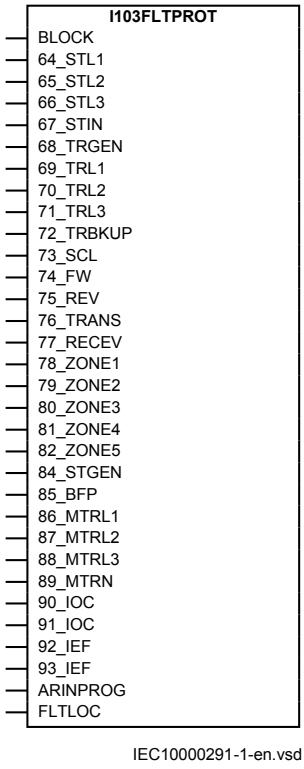

Figure 10: I103FLTPROT function block

4.1.5.3 Signals

Table 17: I103FLTPROT Input signals

Name	Type	Default	Description
BLOCK	BOOLEAN	0	Block of status reporting.
64_STL1	BOOLEAN	0	Information number 64, start phase L1
65_STL2	BOOLEAN	0	Information number 65, start phase L2
66_STL3	BOOLEAN	0	Information number 66, start phase L3
67_STIN	BOOLEAN	0	Information number 67, start residual current IN
68_TRGEN	BOOLEAN	0	Information number 68, trip general
69_TRL1	BOOLEAN	0	Information number 69, trip phase L1
70_TRL2	BOOLEAN	0	Information number 70, trip phase L2
71_TRL3	BOOLEAN	0	Information number 71, trip phase L3
72_TRBKUP	BOOLEAN	0	Information number 72, back up trip I>>

Table continues on next page

Name	Type	Default	Description
73_SCL	REAL	0	Information number 73, fault location in ohm
74_FW	BOOLEAN	0	Information number 74, forward/line
75_REV	BOOLEAN	0	Information number 75, reverse/busbar
76_TRANS	BOOLEAN	0	Information number 76, signal transmitted
77_RECEV	BOOLEAN	0	Information number 77, signal received
78_ZONE1	BOOLEAN	0	Information number 78, zone 1
79_ZONE2	BOOLEAN	0	Information number 79, zone 2
80_ZONE3	BOOLEAN	0	Information number 80, zone 3
81_ZONE4	BOOLEAN	0	Information number 81, zone 4
82_ZONE5	BOOLEAN	0	Information number 82, zone 5
84_STGEN	BOOLEAN	0	Information number 84, start general
85_BFP	BOOLEAN	0	Information number 85, breaker failure
86_MTRL1	BOOLEAN	0	Information number 86, trip measuring system phase L1
87_MTRL2	BOOLEAN	0	Information number 87, trip measuring system phase L2
88_MTRL3	BOOLEAN	0	Information number 88, trip measuring system phase L3
89_MTRN	BOOLEAN	0	Information number 89, trip measuring system neutral N
90_IOC	BOOLEAN	0	Information number 90, over current trip, stage low
91_IOC	BOOLEAN	0	Information number 91, over current trip, stage high
92_IEF	BOOLEAN	0	Information number 92, earth-fault trip, stage low
93_IEF	BOOLEAN	0	Information number 93, earth-fault trip, stage high
ARINPROG	BOOLEAN	0	Autorecloser in progress (SMBRREC- INPROGR)
FLTLOC	BOOLEAN	0	Faultlocator faultlocation valid (LMBRFLO-CALCMADE)

4.1.5.4 Settings

Table 18: I103FLTPROT Non group settings (basic)

Name	Values (Range)	Unit	Step	Default	Description
FunctionType	1 - 255	-	1	128	Function type (1-255)

4.1.5.5 Supported information types

Function status fault protection for IEC60870-5-103, I103FLTPROT

Number of instances: 1

Function type is selected with parameter *FunctionType*.

Information number is defined for each input signals.

Info. no.	Message	Supported	TYPE	GI	COT
64	Start phase L1	Yes	2	Y	1,7,9
65	Start phase L2	Yes	2	Y	1,7,9
66	Start phase L3	Yes	2	Y	1,7,9
67	Start residual current IN	Yes	2	Y	1,7,9
68	Trip general	Yes	2	N	1,7
69	Trip phase L1	Yes	2	N	1,7
70	Trip phase L2	Yes	2	N	1,7
71	Trip phase L3	Yes	2	N	1,7
72	Back up trip I>>	Yes	2	N	1,7
73	Fault location in ohm	Yes	4	N	1,7
74	Forward/line	Yes	2	N	1,7
75	Reverse/busbar	Yes	2	N	1,7
76	Signal transmitted	Yes	2	N	1,7
77	Signal received	Yes	2	N	1,7
78	Zone 1	Yes	2	N	1,7
79	Zone 2	Yes	2	N	1,7
80	Zone 3	Yes	2	N	1,7
81	Zone 4	Yes	2	N	1,7
82	Zone 5	Yes	2	N	1,7
83	Zone 6	No	2	N	1,7
84	Start general	Yes	2	Y	1,7,9
85	Breaker failure	Yes	2	N	1,7
86	Trip measuring system phase L1	Yes	2	N	1,7
87	Trip measuring system phase L2	Yes	2	N	1,7
88	Trip measuring system phase L3	Yes	2	N	1,7
89	Trip measuring system neutral N	Yes	2	N	1,7
90	Over current trip, stage low	Yes	2	N	1,7
91	Over current trip, stage high	Yes	2	N	1,7
92	Earth-fault trip, stage low	Yes	2	N	1,7
93	Earth-fault trip, stage high	Yes	2	N	1,7

4.1.6 IED status for IEC 60870-5-103 I103IED

4.1.6.1 Functionality

I103IED is a function block with defined IED functions in monitor direction. This block uses parameter as *FunctionType*, and information number parameter is defined for each input signal.

4.1.6.2 Function block

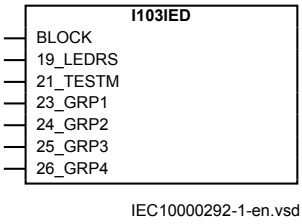

Figure 11: I103IED function block

4.1.6.3 Signals

Table 19: I103IED Input signals

Name	Type	Default	Description
BLOCK	BOOLEAN	0	Block of status reporting
19_LEDRS	BOOLEAN	0	Information number 19, reset LEDs
21_TESTM	BOOLEAN	0	Information number 21, test mode is active
23_GRP1	BOOLEAN	0	Information number 23, setting group 1 is active
24_GRP2	BOOLEAN	0	Information number 24, setting group 2 is active
25_GRP3	BOOLEAN	0	Information number 25, setting group 3 is active
26_GRP4	BOOLEAN	0	Information number 26, setting group 4 is active

4.1.6.4 Settings

Table 20: I103IED Non group settings (basic)

Name	Values (Range)	Unit	Step	Default	Description
FunctionType	1 - 255	-	1	1	Function type (1-255)

4.1.6.5 Supported information types

Terminal status indications in monitor direction, I103IED

Number of instances: 1

Function type is selected with parameter *FunctionType*.

Information number is defined for each input signals.

Info. no.	Message	Supported
19	LED reset	Yes
20	Monitor direction blocked	No
21	TestMode	No
22	Local Parameter setting	Yes
Table continues on next page		

Info. no.	Message	Supported
23	Setting group 1 active	Yes
24	Setting group 2 active	Yes
25	Setting group 3 active	Yes
26	Setting group 4 active	Yes

4.1.7 Supervison status for IEC 60870-5-103 I103SUPERV

4.1.7.1 Functionality

I103SUPERV is a function block with defined functions for supervision indications in monitor direction. This block includes the *FunctionType* parameter, and the information number parameter is defined for each output signal.

4.1.7.2 Function block

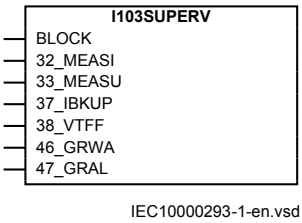

Figure 12: I103SUPERV function block

4.1.7.3 Signals

Table 21: I103SUPERV Input signals

Name	Type	Default	Description
BLOCK	BOOLEAN	0	Block of status reporting
32_MEASI	BOOLEAN	0	Information number 32, measurand supervision of I
33_MEASU	BOOLEAN	0	Information number 33, measurand supervision of U
37_IBKUP	BOOLEAN	0	Information number 37, I high-high back-up protection
38_VTFF	BOOLEAN	0	Information number 38, fuse failure VT
46_GRWA	BOOLEAN	0	Information number 46, group warning
47_GRAL	BOOLEAN	0	Information number 47, group alarm

4.1.7.4 Settings

Table 22: I103SUPERV Non group settings (basic)

Name	Values (Range)	Unit	Step	Default	Description
FunctionType	1 - 255	-	1	1	Function type (1-255)

4.1.7.5 Supported information types

Supervision indications in monitor direction, I103SUPERV

Number of instances: 1

Function type is selected with parameter *FunctionType*.

Information number is defined for output signals.

Info. no.	Message	Supported	Type	GI	COT
32	Measurand supervision I	Yes	1	Y	1,7,9
33	Measurand supervision U	Yes	1	Y	1,7,9
35	Phase sequence supervision	No	1	Y	1,7,9
36	Trip circuit supervision	No	1	Y	1,7,9
37	I>>back-up operation	Yes	1	Y	1,7,9
38	VT fuse failure	Yes	1	Y	1,7,9
39	Teleprotection disturbed	No	1	Y	1,7,9
46	Group warning	Yes	1	Y	1,7,9
47	Group alarm	Yes	1	Y	1,7,9

4.1.8 Status for user defined signals for IEC 60870-5-103 I103USRDEF

4.1.8.1 Functionality

I103USRDEF is a function blocks with user defined input signals in monitor direction. These function blocks include the *FunctionType* parameter for each block in the private range, and the information number parameter for each input signal.

I103USRDEF can be used, for example in mapping the INF numbers not supported directly by specific function blocks, like: INF17, INF18, INF20 or INF35. After connecting the appropriate signals to the I103USRDEF inputs, the user must also set the *InfNo_x* values in the settings.

I103USRDEF: 1					
FunctionType		5		1	255
NAME1		INPUT1			13 character(s
InfNo_1		**17**		1	255
NAME2		INPUT2			13 character(s
InfNo_2		**18**		1	255
NAME3		INPUT3			13 character(s
InfNo_3		**20**		1	255
NAME4		INPUT4			13 character(s
InfNo_4		**35**		1	255

Figure 13: IEC 60870-5-103I103USRDEF:1

4.1.8.2 Function block

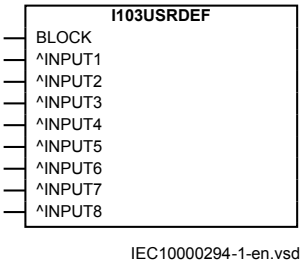

Figure 14: I103USRDEF function block

4.1.8.3 Signals

Table 23: I103USRDEF Input signals

Name	Type	Default	Description
BLOCK	BOOLEAN	0	Block of status reporting
INPUT1	BOOLEAN	0	Binary signal Input 1
INPUT2	BOOLEAN	0	Binary signal input 2
INPUT3	BOOLEAN	0	Binary signal input 3
INPUT4	BOOLEAN	0	Binary signal input 4
INPUT5	BOOLEAN	0	Binary signal input 5
INPUT6	BOOLEAN	0	Binary signal input 6
INPUT7	BOOLEAN	0	Binary signal input 7
INPUT8	BOOLEAN	0	Binary signal input 8

4.1.8.4 Settings

Table 24: I103USRDEF Non group settings (basic)

Name	Values (Range)	Unit	Step	Default	Description
FunctionType	1 - 255	-	1	5	Function type (1-255)
InfNo_1	1 - 255	-	1	1	Information number for binary input 1 (1-255)
InfNo_2	1 - 255	-	1	2	Information number for binary input 2 (1-255)
InfNo_3	1 - 255	-	1	3	Information number for binary input 3 (1-255)
InfNo_4	1 - 255	-	1	4	Information number for binary input 4 (1-255)
InfNo_5	1 - 255	-	1	5	Information number for binary input 5 (1-255)
InfNo_6	1 - 255	-	1	6	Information number for binary input 6 (1-255)
InfNo_7	1 - 255	-	1	7	Information number for binary input 7 (1-255)
InfNo_8	1 - 255	-	1	8	Information number for binary input 8 (1-255)

4.1.8.5 Supported information types

Function status indications in monitor direction, user-defined, I103USRDEF

Number of instances: 20

Function type is selected with parameter *FunctionType* for each function block instance in private range. Default values are defined in private range 5 - 24. One for each instance.

Information number is required for each input signal. Default values are defined in range 1 - 8.

Info. no.	Message	Supported
1	Input signal 01	Yes
2	Input signal 02	Yes
3	Input signal 03	Yes
4	Input signal 04	Yes
5	Input signal 05	Yes
6	Input signal 06	Yes
7	Input signal 07	Yes
8	Input signal 08	Yes

4.2 Commands in control direction

4.2.1 Function commands for IEC 60870-5-103 I103CMD

4.2.1.1 Functionality

I103CMD is a command function block in control direction with pre-defined output signals.

4.2.1.2 Function block

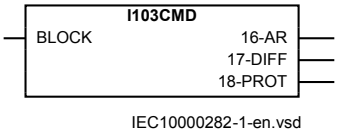

Figure 15: I103CMD function block

4.2.1.3 Signals

Table 25: I103CMD Input signals

Name	Type	Default	Description
BLOCK	BOOLEAN	0	Block of commands

Table 26: I103CMD Output signals

Name	Type	Description
16-AR	BOOLEAN	Information number 16, block of autorecloser
17-DIFF	BOOLEAN	Information number 17, block of differential protection
18-PROT	BOOLEAN	Information number 18, block of protection

4.2.1.4 Settings

Table 27: I103CMD Non group settings (basic)

Name	Values (Range)	Unit	Step	Default	Description
FunctionType	1 - 255	-	1	1	Function type (1-255)

4.2.1.5 Supported information types

Function commands in control direction, pre-defined I103CMD

Number of instances: 1

Function type is selected with parameter *FunctionType* .

Information number is defined for each output signals.

Info. no.	Message	Supported
16	Auto-recloser on/off	Yes
17	Teleprotection on/off	Yes
18	Protection on/off	Yes

4.2.2 IED commands for IEC 60870-5-103 I103IEDCMD

4.2.2.1 Functionality

I103IEDCMD is a command block in control direction with defined IED functions.

4.2.2.2 Function block

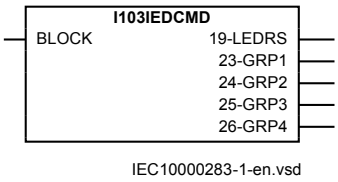

Figure 16: I103IEDCMD function block

4.2.2.3 Signals

Table 28: I103IEDCMD Input signals

Name	Type	Default	Description
BLOCK	BOOLEAN	0	Block of commands

Table 29: I103IEDCMD Output signals

Name	Type	Description
19-LEDRS	BOOLEAN	Information number 19, reset LEDs
23-GRP1	BOOLEAN	Information number 23, activate setting group 1
24-GRP2	BOOLEAN	Information number 24, activate setting group 2
25-GRP3	BOOLEAN	Information number 25, activate setting group 3
26-GRP4	BOOLEAN	Information number 26, activate setting group 4

4.2.2.4 Settings

Table 30: I103IEDCMD Non group settings (basic)

Name	Values (Range)	Unit	Step	Default	Description
FunctionType	1 - 255	-	1	255	Function type (1-255)

4.2.2.5 Supported information types

Commands in control direction, I103IEDCMD

Number of instances: 1

Function type is selected with parameter *FunctionType*.

Information number is defined for each output signals.

Info. no	Message	Supported
19	LED Reset	Yes
23	Activate setting group 1	Yes
24	Activate setting group 2	Yes
25	Activate setting group 3	Yes
26	Activate setting group 4	Yes

4.2.3 Function commands user defined for IEC 60870-5-103 I103USRCMD

4.2.3.1 Functionality

I103USRCMD is a command block in control direction with user defined output signals. These function blocks include the *FunctionType* parameter for each block in the private range, and the Information number parameter for each output signal.

4.2.3.2 Function block

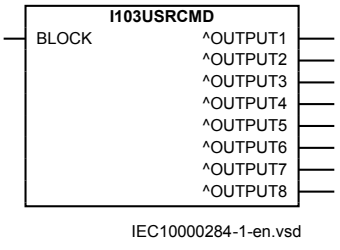

Figure 17: I103USRCMD function block

4.2.3.3 Signals

Table 31: I103USRCMD Input signals

Name	Type	Default	Description
BLOCK	BOOLEAN	0	Block of commands

Table 32: I103USRCMD Output signals

Name	Type	Description
OUTPUT1	BOOLEAN	Command output 1
OUTPUT2	BOOLEAN	Command output 2
OUTPUT3	BOOLEAN	Command output 3
OUTPUT4	BOOLEAN	Command output 4
OUTPUT5	BOOLEAN	Command output 5
OUTPUT6	BOOLEAN	Command output 6
OUTPUT7	BOOLEAN	Command output 7
OUTPUT8	BOOLEAN	Command output 8

4.2.3.4 Settings

Table 33: I103USRCMD Non group settings (basic)

Name	Values (Range)	Unit	Step	Default	Description
FunctionType	1 - 255	-	1	1	Function type (1-255)
PulseMode	Steady Pulsed	-	-	Pulsed	Pulse mode
PulseLength	0.200 - 60.000	s	0.001	0.400	Pulse length
InfNo_1	1 - 255	-	1	1	Information number for output 1 (1-255)
InfNo_2	1 - 255	-	1	2	Information number for output 2 (1-255)
InfNo_3	1 - 255	-	1	3	Information number for output 3 (1-255)
InfNo_4	1 - 255	-	1	4	Information number for output 4 (1-255)
InfNo_5	1 - 255	-	1	5	Information number for output 5 (1-255)
InfNo_6	1 - 255	-	1	6	Information number for output 6 (1-255)
InfNo_7	1 - 255	-	1	7	Information number for output 7 (1-255)
InfNo_8	1 - 255	-	1	8	Information number for output 8 (1-255)

4.2.3.5 Supported information types

Function commands in control direction, user-defined, I103USRCMD

Number of instances: 4

Function type for each function block instance in private range is selected with parameter *FunctionType*. Default values are defined in private range 1 - 4. One for each instance.

Information number must be selected for each output signal. Default values are 1 - 8.

Info. no.	Message	Supported
1	Output signal 01	Yes
2	Output signal 02	Yes
3	Output signal 03	Yes
4	Output signal 04	Yes
5	Output signal 05	Yes
6	Output signal 06	Yes
7	Output signal 07	Yes
8	Output signal 08	Yes

4.2.4 Function commands generic for IEC 60870-5-103 I103GENCMD

4.2.4.1 Functionality

I103GENCMD is used for transmitting generic commands over IEC 60870-5-103. The function has two outputs signals CMD_OFF and CMD_ON that can be used to implement double-point command schemes.

4.2.4.2 Function block

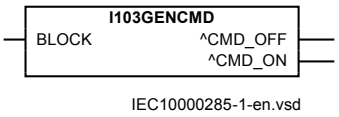

Figure 18: I103GENCMD function block

4.2.4.3 Signals

Table 34: I103GENCMD Input signals

Name	Type	Default	Description
BLOCK	BOOLEAN	0	Block of command

Table 35: I103GENCMD Output signals

Name	Type	Description
CMD_OFF	BOOLEAN	Command output OFF
CMD_ON	BOOLEAN	Command output ON

4.2.4.4 Settings

Table 36: I103GENCMD Non group settings (basic)

Name	Values (Range)	Unit	Step	Default	Description
FunctionType	1 - 127	-	1	1	Function type (1-255)
PulseLength	0.000 - 60.000	s	0.001	0.400	Pulse length
InfNo	32 - 239	-	1	32	Information number for command output (1-255)

4.2.4.5 Supported information types

Function commands generic for IEC60870-5-103, I103GENCMD

Number of instances: 50

Function type for each function block instance is selected with parameter *FunctionType*.

Information number must be selected for command output.

4.2.5 IED commands with position and select for IEC 60870-5-103 I103POSCMD

4.2.5.1 Functionality

I103POSCMD has double-point position indicators that are getting the position value as an integer (for example from the POSITION output of the SCSWI function block) and sending it over IEC 60870-5-103 (1=OPEN; 2=CLOSE); as per standard, *0* and *3* values of the position are not supported.

The BLOCK input will block only the signals in monitoring direction (the position information), not the commands via IEC 60870-5-103. The SELECT input is used to indicate that the monitored apparatus has been selected (in a select-before-operate type of control)

4.2.5.2 Function block

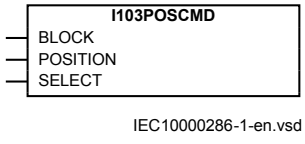

Figure 19: I103POSCMD function block

4.2.5.3 Signals

Table 37: I103POSCMD Input signals

Name	Type	Default	Description
BLOCK	BOOLEAN	0	Block of command
POSITION	INTEGER	0	Position of controllable object
SELECT	BOOLEAN	0	Select of controllable object

4.2.5.4 Settings

Table 38: I103POSCMD Non group settings (basic)

Name	Values (Range)	Unit	Step	Default	Description
FunctionType	1 - 255	-	1	1	Function type (1-255)
InfNo	160 - 196	-	4	160	Information number for command output (1-255)

4.2.5.5 Supported information types

IED commands with position and select for IEC60870-5-103, I103POSCMD

Number of instances: 50

Function type for each function block instance is selected with parameter *FunctionType*.

Information number must be selected for command output.

The current implementation of the IEC 60870-5-103 commands will reject any new command if a previously issued command has not yet been completed.

4.3 Disturbance recorder file transfer

4.3.1 Disturbance recordings

- The transfer functionality is based on the Disturbance recorder function. The analog and binary signals recorded will be reported to the master by polling. The eight last disturbances that are recorded are available for transfer to the master. A file that has been transferred and acknowledged by the master cannot be transferred again.
- The binary signals that are reported by polling are those that are connected to the disturbance function blocks B1RBDR to B6RBDR. These function blocks

include the function type and the information number for each signal. For more information on the description of the Disturbance report in the Technical reference manual. The analog channels, that are reported, are those connected to the disturbance function blocks A1RADR to A4RADR. The eight first ones belong to the public range and the remaining ones to the private range.

The following elements are used in the ASDUs (Application Service Data Units) defined in the standard.

Analog signals, 40-channels: the channel number for each channel has to be specified. Channels used in the public range are 1 to 8 and with:

- I_{L1} connected to channel 1 on disturbance function block A1RADR
- I_{L2} connected to channel 2 on disturbance function block A1RADR
- I_{L3} connected to channel 3 on disturbance function block A1RADR
- I_N connected to channel 4 on disturbance function block A1RADR
- V_{L1E} connected to channel 5 on disturbance function block A1RADR
- V_{L2E} connected to channel 6 on disturbance function block A1RADR
- V_{L3E} connected to channel 7 on disturbance function block A1RADR
- V_{EN} connected to channel 8 on disturbance function block A1RADR

Channel number used for the remaining 32 analog signals are numbers in the private range 64 to 95.

Binary signals, 96-channels: for each channel the user can specify a FUNCTION TYPE and an INFORMATION NUMBER.

For each input of the Disturbance recorder function there is a setting for the information number of the connected signal. The information number can be set to any value between 0 and 255.

Furthermore, there is a setting on each input of the Disturbance recorder function for the function type. Refer to description of Main Function type set on the local HMI.

Disturbance upload

All analog and binary signals that are recorded with disturbance recorder can be reported to the master. The last eight disturbances that are recorded are available for transfer to the master. A successfully transferred disturbance (acknowledged by the master) will not be reported to the master again.

When a new disturbance is recorded by the IED a list of available recorded disturbances will be sent to the master, an updated list of available disturbances can be sent whenever something has happened to disturbances in this list. For example, when a disturbance is deteceted (by other client, for example, SPA) or when a new disturbance has been recorded or when the master has uploaded a disturbance.

Deviations from the standard

This section describes all data that is not exactly as specified in the standard.

ASDU23

In ‘list of recorded disturbances’ (ASDU23) an information element named SOF (status of fault) exists. This information element consists of 4 bits and indicates whether:

- Bit TP: the protection equipment has tripped during the fault
- Bit TM: the disturbance data are currently being transmitted
- Bit TEST: the disturbance data have been recorded during normal operation or test mode.
- Bit OTEV: the disturbance data recording has been initiated by another event than start

The only information that is easily available is test-mode status. The other information is always set (hard coded) to:

TP	Recorded fault with trip. [1]
TM	Disturbance data waiting for transmission [0]
OTEV	Disturbance data initiated by other events [1]

Another information element in ASDU23 is the FAN (fault number). According to the standard this is a number that is incremented when a protection function takes action.

ASDU26

When a disturbance has been selected by the master; (by sending ASDU24), the protection equipment answers by sending ASDU26, which contains an information element named NOF (number of grid faults). This number must indicate fault number in the power system,that is, a fault in the power system with several trip and auto-reclosing has the same NOF (while the FAN must be incremented).

To get INF and FUN for the recorded binary signals there are parameters on the disturbance recorder for each input. The user must set these parameters to whatever he connects to the corresponding input.

Section 5 Interoperability

5.1 Physical layer

Table 39: Electrical Interface

	Supported
EIA RS-485	No
number of loads	No

5.1.1 Optical interface

Table 40: Optical interface

	Supported
Glass fibre	Yes
Plastic fibre	No
F-SMA type connector	No
BFOC/2,5 type connector	Yes

5.1.2 Transmission speed

Table 41: Transmission speed

	Supported
9 600 bit/s	Yes
19 200 bit/s	Yes

5.2 Application layer

5.2.1 Transmission mode for application data

Mode 1 (least significant octet first), as defined in 4.10 of IEC 60870-5-4, is used exclusively in this companion standard.

5.2.2 Common address of ASDU

Table 42: Common address of ASDU

	Supported
One COMMON ADDRESS OF ASDU (identical with station address)	Yes
More than one COMMON ADDRESS OF ASDU	No

5.2.3 Selection of standard information numbers in monitor direction

5.2.3.1 System functions in monitor direction

Table 43: System functions in monitor direction

INF	Semantics	Supported
0	End of general interrogation	Yes
0	Time synchronization	Yes
2	Reset FCB	Yes
3	Reset CU	Yes
4	Start/restart	Yes
5	Power on	No

5.2.3.2 Status indications in monitor direction

Table 44: Status indications in monitor direction

INF	Semantics	Supported
16	Auto-recloser active	Yes
17	Teleprotection active	No
18	Protection active	No
19	LED reset	Yes
20	Monitor direction blocked	No
21	Test mode	Yes
22	Local parameter setting	No
23 to 26	Characteristic 1 to Characteristic 4	Yes
27 to 30	Auxiliary input 1 to Auxiliary input 4	No

5.2.3.3 Supervision indications in monitor direction

Table 45: Supervision indications in monitor direction

INF	Semantics	Supported
32	Measurand supervision I	Yes
33	Measurand supervision V	Yes
35	Phase sequence supervision	No
36	Trip circuit supervision	No
37	I>> back-up operation	Yes
38	VT fuse failure	Yes
39	Teleprotection disturbed	No
46	Group warning	Yes
47	Group alarm	Yes

5.2.3.4 Earth fault indications in monitor direction

Table 46: Earth fault indications in monitor direction

INF	Semantics	Supported
48 to 50	Earth fault L_1 to Earth fault L_3	No
51	Earth fault forward, i.e. Line	Yes
52	Earth fault reverse, i.e. Busbar	Yes

5.2.3.5 Fault indications in monitor direction

Table 47: Fault indications in monitor direction

INF	Semantics	Supported
64 to 66	Start /pick-up L_1 to Start /pick-up L_3	Yes
67	Start /pick-up N	Yes
68	General trip	Yes
69 to 71	Trip L_1 to Trip L_3	Yes
72	Trip I>> (back-up operation)	Yes
73	Fault location X in ohms	Yes
74	Fault forward/line	Yes
75	Fault reverse/busbar	Yes
76	Teleprotection signal transmitted	Yes
77	Teleprotection signal received	Yes
78 to 82	Zone 1 to Zone 5	Yes
83	Zone 6	No

Table continues on next page

INF	Semantics	Supported
84	General start/pick-up	Yes
85	Breaker failure	Yes
86 to 88	Trip measuring system L_1 to Trip measuring system L_3	Yes
89	Trip measuring system E	Yes
90	Trip I>	Yes
91	Trip I>>	Yes
92	Trip IN>	Yes
93	Trip IN>>	Yes

5.2.3.6 Auto-reclosure indications in monitor direction

Table 48: Auto-reclosure indications in monitor direction

INF	Semantics	Supported
128	CB ‘on’ by AR	Yes
129	CB ‘on’ by long-time AR	No
130	AR blocked	Yes

5.2.3.7 Measurands in monitor direction

Table 49: Measurands in monitor direction

INF	Semantics	Supported
144	Measurand I	Yes
145	Measurands I, V	Yes
146	Measurands I, V, P, Q	Yes
147	Measurands I_N, V_{EN}	Yes
148	Measurands $I_{L1,2,3,}$ $V_{L1,2,3,}$ P, Q, f	Yes

5.2.3.8 Generic functions in monitor direction

Table 50: Generic functions in monitor direction

INF	Semantics	Supported
240	Read headings of all defined groups	No
241	Read values or attributes of all entries of one group	No
243	Read directory of a single entry	No
244	Read value or attribute of a single entry	No
245	End of general interrogation of generic data	No
249	Write entry with confirmation	No
250	Write entry with execution	No
251	Write entry aborted	No

5.2.4 Selection of standard information numbers in control direction

5.2.4.1 System functions in control direction

Table 51: System functions in control direction

INF	Semantics	Supported
0	Initiation of general interrogation	Yes
0	Time synchronization	Yes

5.2.4.2 General commands in control direction

Table 52: General commands in control direction

INF	Semantics	Supported
16	Auto-recloser on/off	Yes
17	Teleprotection on/off	Yes
18	Protection on/off	Yes
19	LED reset	Yes
23 to 26	Activate characteristic 1 to Activate characteristic 4	Yes

5.2.4.3 Generic functions in control direction

Table 53: Generic functions in control direction

INF	Semantics	Supported
240	Read headings of all defined groups	No
241	Read values or attributes of all entries of one group	No
243	Read directory of a single entry	No
244	Read value or attribute of a single entry	No
245	General interrogation of generic data	No
248	Write entry	No
249	Write entry with confirmation	No
250	Write entry with execution	No
251	Write entry abort	No

5.2.5 Basic application functions

Table 54: Basic application functions

Supported	
Yes	Test mode
No	Blocking of monitor direction
Yes	Disturbance data
No	Generic services
Yes	Private data

5.2.6 Miscellaneous

Measurands are transmitted with ASDU 3 as well as with ASDU 9. As defined in 7.2.6.8, the maximum MVAL can either be 1,2 or 2,4 times the rated value. No different rating shall be used in ASDU 3 and ASDU 9, i.e. for each measurand there is only one choice.

Table 55: Miscellaneous

Measurand	Max. MVAL = rated value times	
	1,2	2,4
Current L_1	Yes	Yes
Current L_2	Yes	Yes
Current L_3	Yes	Yes
Voltage L_{1-E}	Yes	Yes
Voltage L_{2-E}	Yes	Yes
Voltage L_{3-E}	Yes	Yes
Active power P	Yes	Yes
Reactive power Q	Yes	Yes
Frequency f	Yes	Yes
Voltage L_1 - L_2	Yes	Yes

Recorded analog channels are sent with ASDU26 and ASDU31. One information element in these ASDUs is called ACC and indicates the actual channel to be processed. The channels on disturbance recorder will be sent with an ACC according to the following table:

DRA#-Input	ACC	IEC103 meaning
1	1	IL1
2	2	IL2
3	3	IL3
4	4	IN
Table continues on next page		

DRA#-Input	ACC	IEC103 meaning
5	5	UL1
6	6	UL2
7	7	UL3
8	8	UN
9	64	Private range
10	65	Private range
11	66	Private range
12	67	Private range
13	68	Private range
14	69	Private range
15	70	Private range
16	71	Private range
17	72	Private range
18	73	Private range
19	74	Private range
20	75	Private range
21	76	Private range
22	77	Private range
23	78	Private range
24	79	Private range
25	80	Private range
26	81	Private range
27	82	Private range
28	83	Private range
29	84	Private range
30	85	Private range
31	86	Private range
32	87	Private range
33	88	Private range
34	89	Private range
35	90	Private range
36	91	Private range
37	92	Private range
38	93	Private range
39	94	Private range
40	95	Private range

Section 6 Glossary

AC	Alternating current
ACT	Application configuration tool within PCM600
A/D converter	Analog-to-digital converter
ADBS	Amplitude deadband supervision
AI	Analog input
ANSI	American National Standards Institute
AR	Autoreclosing
ASCT	Auxiliary summation current transformer
ASD	Adaptive signal detection
AWG	American Wire Gauge standard
BI	Binary input
BOS	Binary outputs status
BR	External bistable relay
BS	British Standards
CAN	Controller Area Network. ISO standard (ISO 11898) for serial communication
CB	Circuit breaker
CCITT	Consultative Committee for International Telegraph and Telephony. A United Nations-sponsored standards body within the International Telecommunications Union.
CCVT	Capacitive Coupled Voltage Transformer
Class C	Protection Current Transformer class as per IEEE/ ANSI
CMPPS	Combined megapulses per second
CMT	Communication Management tool in PCM600
CO cycle	Close-open cycle
Codirectional	Way of transmitting G.703 over a balanced line. Involves two twisted pairs making it possible to transmit information in both directions
COMTRADE	Standard format according to IEC 60255-24
Contra-directional	Way of transmitting G.703 over a balanced line. Involves four twisted pairs, two of which are used for transmitting data in both directions and two for transmitting clock signals

CPU	Central processor unit
CR	Carrier receive
CRC	Cyclic redundancy check
CROB	Control relay output block
CS	Carrier send
CT	Current transformer
CVT	Capacitive voltage transformer
DAR	Delayed autoreclosing
DARPA	Defense Advanced Research Projects Agency (The US developer of the TCP/IP protocol etc.)
DBDL	Dead bus dead line
DBLL	Dead bus live line
DC	Direct current
DFC	Data flow control
DFT	Discrete Fourier transform
DHCP	Dynamic Host Configuration Protocol
DIP-switch	Small switch mounted on a printed circuit board
DI	Digital input
DLLB	Dead line live bus
DNP	Distributed Network Protocol as per IEEE/ANSI Std. 1379-2000
DR	Disturbance recorder
DRAM	Dynamic random access memory
DRH	Disturbance report handler
DSP	Digital signal processor
DTT	Direct transfer trip scheme
EHV network	Extra high voltage network
EIA	Electronic Industries Association
EMC	Electromagnetic compatibility
EMF	(Electric Motive Force)
EMI	Electromagnetic interference
EnFP	End fault protection
EPA	Enhanced performance architecture
ESD	Electrostatic discharge
FCB	Flow control bit; Frame count bit

FOX 20	Modular 20 channel telecommunication system for speech, data and protection signals
FOX 512/515	Access multiplexer
FOX 6Plus	Compact time-division multiplexer for the transmission of up to seven duplex channels of digital data over optical fibers
G.703	Electrical and functional description for digital lines used by local telephone companies. Can be transported over balanced and unbalanced lines
GCM	Communication interface module with carrier of GPS receiver module
GDE	Graphical display editor within PCM600
GI	General interrogation command
GIS	Gas-insulated switchgear
GOOSE	Generic object-oriented substation event
GPS	Global positioning system
HDLC protocol	High-level data link control, protocol based on the HDLC standard
HFBR connector type	Plastic fiber connector
HMI	Human-machine interface
HSAR	High speed autoreclosing
HV	High-voltage
HVDC	High-voltage direct current
IDBS	Integrating deadband supervision
IEC	International Electrical Committee
IEC 60044-6	IEC Standard, Instrument transformers – Part 6: Requirements for protective current transformers for transient performance
IEC 61850	Substation automation communication standard
IEEE	Institute of Electrical and Electronics Engineers
IEEE 802.12	A network technology standard that provides 100 Mbits/s on twisted-pair or optical fiber cable
IEEE P1386.1	PCI Mezzanine Card (PMC) standard for local bus modules. References the CMC (IEEE P1386, also known as Common Mezzanine Card) standard for the mechanics and the PCI specifications from the PCI SIG (Special Interest Group) for the electrical EMF (Electromotive force).
IED	Intelligent electronic device

I-GIS	Intelligent gas-insulated switchgear
Instance	When several occurrences of the same function are available in the IED, they are referred to as instances of that function. One instance of a function is identical to another of the same kind but has a different number in the IED user interfaces. The word "instance" is sometimes defined as an item of information that is representative of a type. In the same way an instance of a function in the IED is representative of a type of function.
IP	1. Internet protocol. The network layer for the TCP/IP protocol suite widely used on Ethernet networks. IP is a connectionless, best-effort packet-switching protocol. It provides packet routing, fragmentation and reassembly through the data link layer. 2. Ingression protection, according to IEC standard
IP 20	Ingression protection, according to IEC standard, level 20
IP 40	Ingression protection, according to IEC standard, level 40
IP 54	Ingression protection, according to IEC standard, level 54
IRF	Internal failure signal
IRIG-B:	InterRange Instrumentation Group Time code format B, standard 200
ITU	International Telecommunications Union
LAN	Local area network
LIB 520	High-voltage software module
LCD	Liquid crystal display
LDD	Local detection device
LED	Light-emitting diode
MCB	Miniature circuit breaker
MCM	Mezzanine carrier module
MVB	Multifunction vehicle bus. Standardized serial bus originally developed for use in trains.
NCC	National Control Centre
OCO cycle	Open-close-open cycle
OCP	Overcurrent protection
OLTC	On-load tap changer
OV	Over-voltage
Overreach	A term used to describe how the relay behaves during a fault condition. For example, a distance relay is overreaching when the impedance presented to it is smaller than the

	apparent impedance to the fault applied to the balance point, that is, the set reach. The relay “sees” the fault but perhaps it should not have seen it.
PCI	Peripheral component interconnect, a local data bus
PCM	Pulse code modulation
PCM600	Protection and control IED manager
PC-MIP	Mezzanine card standard
PISA	Process interface for sensors & actuators
PMC	PCI Mezzanine card
POR	Permissive overreach
POTT	Permissive overreach transfer trip
Process bus	Bus or LAN used at the process level, that is, in near proximity to the measured and/or controlled components
PSM	Power supply module
PST	Parameter setting tool within PCM600
PT ratio	Potential transformer or voltage transformer ratio
PUTT	Permissive underreach transfer trip
RASC	Synchrocheck relay, COMBIFLEX
RCA	Relay characteristic angle
RFPP	Resistance for phase-to-phase faults
RFPE	Resistance for phase-to-earth faults
RISC	Reduced instruction set computer
RMS value	Root mean square value
RS422	A balanced serial interface for the transmission of digital data in point-to-point connections
RS485	Serial link according to EIA standard RS485
RTC	Real-time clock
RTU	Remote terminal unit
SA	Substation Automation
SBO	Select-before-operate
SC	Switch or push button to close
SCS	Station control system
SCADA	Supervision, control and data acquisition
SCT	System configuration tool according to standard IEC 61850
SDU	Service data unit

SMA connector	Subminiature version A, A threaded connector with constant impedance.
SMT	Signal matrix tool within PCM600
SMS	Station monitoring system
SNTP	Simple network time protocol – is used to synchronize computer clocks on local area networks. This reduces the requirement to have accurate hardware clocks in every embedded system in a network. Each embedded node can instead synchronize with a remote clock, providing the required accuracy.
SRY	Switch for CB ready condition
ST	Switch or push button to trip
Starpoint	Neutral point of transformer or generator
SVC	Static VAr compensation
TC	Trip coil
TCS	Trip circuit supervision
TCP	Transmission control protocol. The most common transport layer protocol used on Ethernet and the Internet.
TCP/IP	Transmission control protocol over Internet Protocol. The de facto standard Ethernet protocols incorporated into 4.2BSD Unix. TCP/IP was developed by DARPA for Internet working and encompasses both network layer and transport layer protocols. While TCP and IP specify two protocols at specific protocol layers, TCP/IP is often used to refer to the entire US Department of Defense protocol suite based upon these, including Telnet, FTP, UDP and RDP.
TNC connector	Threaded Neill-Concelman, a threaded constant impedance version of a BNC connector
TPZ, TPY, TPX, TPS	Current transformer class according to IEC
UMT	User management tool
Underreach	A term used to describe how the relay behaves during a fault condition. For example, a distance relay is underreaching when the impedance presented to it is greater than the apparent impedance to the fault applied to the balance point, that is, the set reach. The relay does not “see” the fault but perhaps it should have seen it. See also Overreach.
U/I-PISA	Process interface components that deliver measured voltage and current values
UTC	Coordinated Universal Time. A coordinated time scale, maintained by the Bureau International des Poids et Mesures (BIPM), which forms the basis of a coordinated

	dissemination of standard frequencies and time signals. UTC is derived from International Atomic Time (TAI) by the addition of a whole number of "leap seconds" to synchronize it with Universal Time 1 (UT1), thus allowing for the eccentricity of the Earth's orbit, the rotational axis tilt (23.5 degrees), but still showing the Earth's irregular rotation, on which UT1 is based. The Coordinated Universal Time is expressed using a 24-hour clock, and uses the Gregorian calendar. It is used for aeroplane and ship navigation, where it is also sometimes known by the military name, "Zulu time." "Zulu" in the phonetic alphabet stands for "Z", which stands for longitude zero.
UV	Undervoltage
WEI	Weak end infeed logic
VT	Voltage transformer
X.21	A digital signalling interface primarily used for telecom equipment
$3I_O$	Three times zero-sequence current. Often referred to as the residual or the earth-fault current
$3U_O$	Three times the zero sequence voltage. Often referred to as the residual voltage or the neutral point voltage

Contact us

ABB AB
Substation Automation Products
SE-721 59 Västerås, Sweden
Phone +46 (0) 21 32 50 00
Fax +46 (0) 21 14 69 18

www.abb.com/substationautomation

1MRK 511 243-UEN - © Copyright 2011 ABB. All rights reserved.

Power and productivity
for a better world™